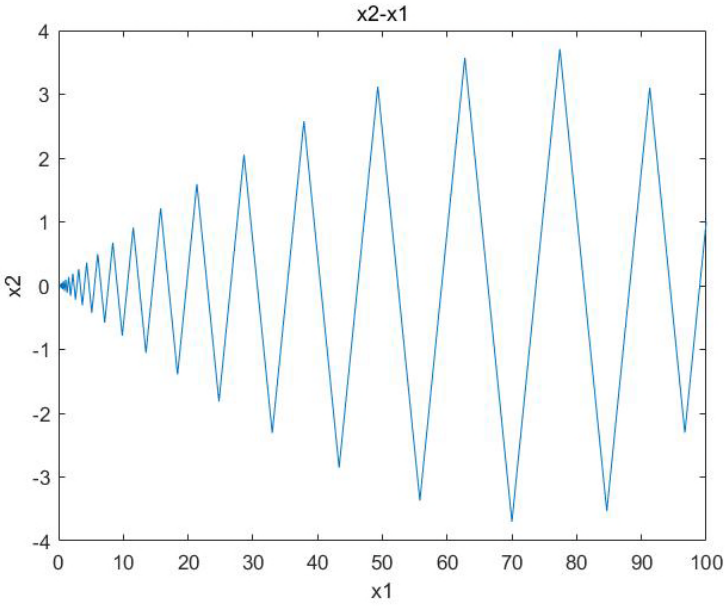
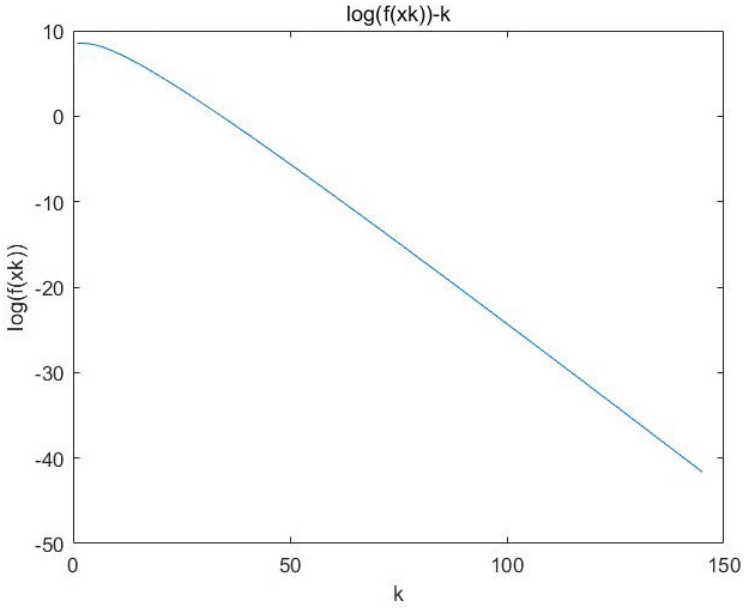
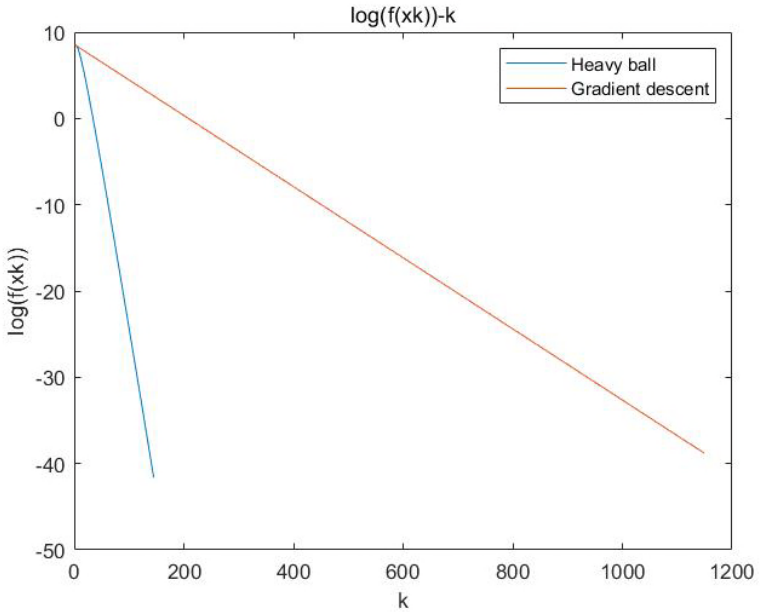
Problem 1

用于对比的梯度下降方法中，用回溯直线搜索，$\alpha = \frac{1}{5}$，$\beta = \frac{1}{2}$，Heavy ball运行图像如：





与梯度方法的对比：



Problem 2

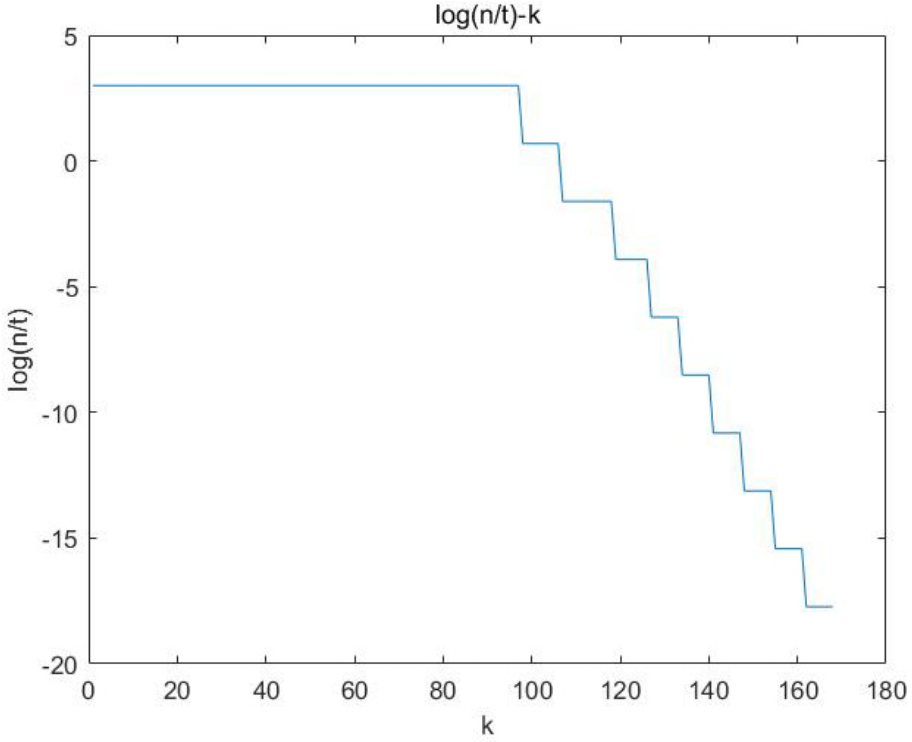
1. $f_0(x) = \frac{1}{2}x^T P x + q^T x$, $\nabla f_0(x) = Px + q$, $\nabla^2 f_0(x) = P$

$\phi(x) = -\sum_{i=1}^{n} \log(x_i)$，其中 x_i 是 x 的第 i 个分量.

$\nabla\phi(x) = (-\frac{1}{x_1}, -\frac{1}{x_2}, \cdots, -\frac{1}{x_n})^T$

$$\nabla^2\phi(x) = \begin{pmatrix} \frac{1}{x_1^2} & & \\ & \frac{1}{x_2^2} & \\ & & \ddots \\ & & & \frac{1}{x_n^2} \end{pmatrix}$$

选取 $\alpha = 0.1$，$\beta = 0.8$，$\mu = 10$，t 初值 10，共迭代 156 次，$p^* = 2.1498e+05$，x^*、λ^*、v^* 保存为 .mat 文件，图像如下：



2. $f(x) = -x$, $Df(x) = \begin{pmatrix} -1 & & \\ & -1 & \\ & & \ddots \\ & & & -1 \end{pmatrix}$ 选用 $\alpha = 0.1$, $\beta = 0.8$, $\mu = 10$, 共迭代 141 次, $p^* = 2.1498e+05$.
x^*, λ^*, v^* 保存为 .mat 文件, 图像如下: